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SOUTH PEQUOP G-E-M RESOURCES AREA

(GRA NO. NV-01)

TECHNICAL REPORT

(WSA NV 010-035)

Contract YA-554-RFP2-1054

Prepared By

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For

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Final Report

April 29, 1983

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EXECUTIVE SUMMARY

The South Pequop Geology-Energy-Minerals (GEM) Resource Area (GRA) is 30 miles west of Wendover in Elko County, Nevada. There is one Wilderness Study Area (WSA): 010-035.

The rocks in the mountains of the GRA are mostly sediments about 200 million to 400 million years old. In the southwestern part of the GRA, in the Spruce Mountain mining district, there are granitic intrusive rocks that are somewhat younger; there are no intrusive or volcanic rocks in the WSA. The valleys adjacent to the ranges are filled with young gravels. Bedrock is everywhere quite complexly faulted.

In the southwestern corner of the GRA is the Spruce Mountain mining district, which has produced about $3 million in lead, silver and gold. There are patented claims in the Spruce Mountain district and numerous unpatented claims, but there are no claims, either patented or unpatented, in WSA NV 010-035. Prospecting permits for phosphate rock in the WSA were held from 1965 to 1972 but none are known to be valid at present.

There are Federal oil and gas leases over about one-half of the WSA, but there are no geothermal leases. There are no sodium and potassium leases.

The entire WSA is classified as having very low favorability for metallic minerals, with low confidence. The entire WSA is classified as having very low favorability for uranium and thorium, with a very low level of confidence. The southern one-fourth of the WSA is classified as moderately favorable for phosphate rock, with a high level of confidence, and two smaller areas have low favorability for phosphate rock with a low level of confidence. Most of the remainder of the WSA has moderate favorability for limestone and dolomite, with a moderate level of confidence. Parts of the eastern and western edges of the WSA have moderate favorability for sand and gravel resources, with a moderate level of confidence.

The entire WSA has low favorability for both oil and gas, and geothermal resources, both with a low confidence level.

The entire WSA has very low favorability for sodium and potassium, with a high level of confidence.

Detailed mapping of the phosphate occurrences is recommended to determine how significant they are. Geochemical sampling is recommended to check for the presence of metallic mineral occurrences.

I. INTRODUCTION

The South Pequop G-E-M Resources Area (GRA No. NV-01) contains approximately 260,000 acres (1,100 sq km) and includes the following Wilderness Study Area (WSA):

WSA Name	WSA Number
South Pequop	NV 010-035

The GRA is located in Nevada in the Bureau of Land Management's (BLM) Wells Resource Area, Elko district. Figure 1 is an index map showing the location of the GRA. The area encompassed is near 40°45' north latitude, 114°40' west longitude and includes the following townships:

T 33 N, R 63-66 E
T 32 N, R 63-66 E
T 31 N, R 63-66 E

The areas of the WSA are on the following U. S. Geological Survey topographic map:

15-minute:

Spruce Mountain 4

The nearest town is Wendover which is located about 30 miles east of WSA NV 010-035. Access to the area is via U. S. Highway 93 to the southwest and light-duty roads east and west of the South Pequop Range. Access within the area is by dirt roads and jeep trails scattered throughout the GRA.

Figure 2 outlines the boundaries of the GRA and the WSA on a topographic base at a scale of 1:250,000.

Figure 3 is a geologic map of the GRA and vicinity, also at 1:250,000. At the end of the report, following the Land Classification Maps, is a geologic time scale showing the various geologic eras, periods and epochs by name as they are used in the text, with the correpsonding age in years. This is so that the reader who is not familiar with geologic time subdivisions will have a comprehensive reference for the geochronology of events.

This GRA Report is one of fifty-five reports on the Geology-Energy-Minerals potential of Wilderness Study Areas in the Basin and Range Province, prepared for the Bureau of Land Management by the Great Basin GEM Joint Venture.

The principals of the Venture are Arthur Baker III, G. Martin Booth III, and Dennis P. Bryan. The study is principally a literature search supplemented by information provided by claim owners, other individuals with knowledge of some areas, and both specific and general experience of the authors. Brief field verification work was conducted on approximately 25 percent of the WSAs covered by the study.

The WSA in this GRA was not field checked.

One original copy of background data specifically applicable to this GEM Resource Area Report has been provided to the BLM as the GRA File. In the GRA File are items such as letters from or notes on telephone conversations with claim owners in the GRA or the WSA, plots of areas of Land Classification for Mineral Resources on maps at larger scale than those that accompany this report if such were made, original compilations of mining claim distribution, any copies of journal articles or other documents that were acquired during the research, and other notes as are deemed applicable by the authors.

As a part of the contract that resulted in this report, a background document was also written: Geological Environments of Energy and Mineral Resources. A copy of this document is included in the GRA File to this GRA report. There are some geological environments that are known to be favorable for certain kinds of mineral deposts, while other environments are known to be much less favorable. In many instances conclusions as to the favorability of areas for the accumulation of mineral resources, drawn in these GRA Reports, have been influenced by the geology of the areas, regardless of whether occurrences of valuable minerals are known to be present. This document is provided to give the reader some understanding of at least the most importnat aspects of geological environments that were in the minds of the authors when they wrote these reports.

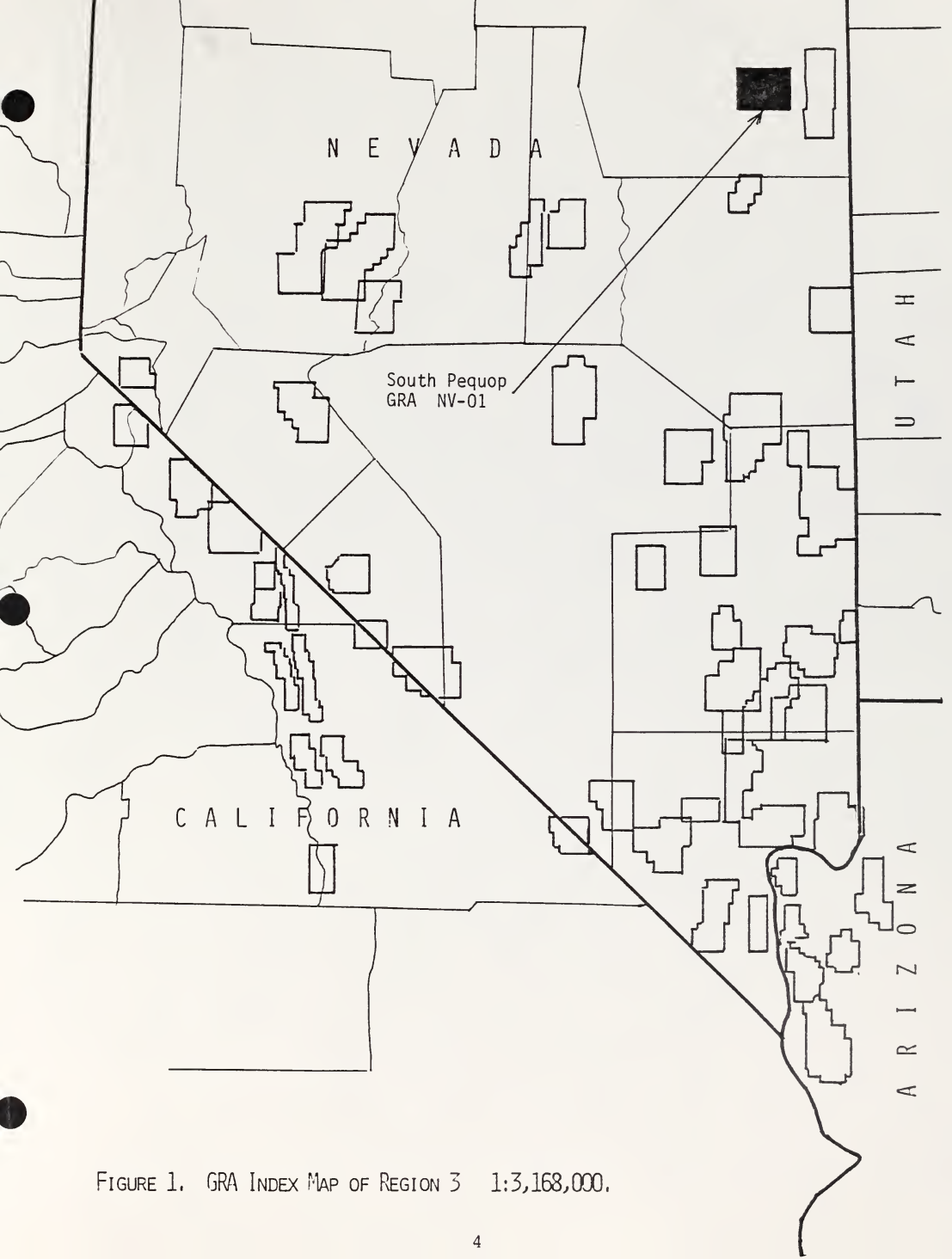
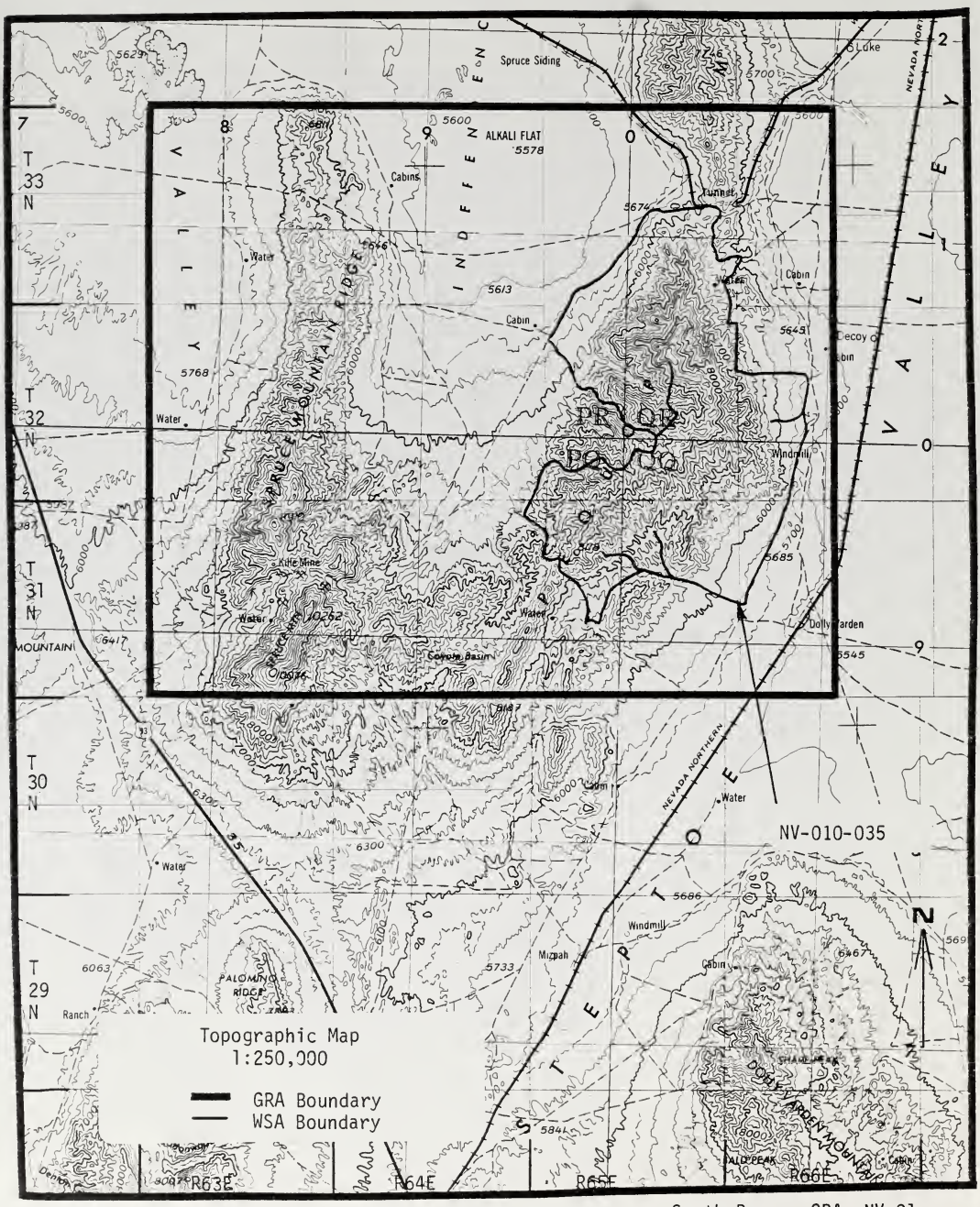


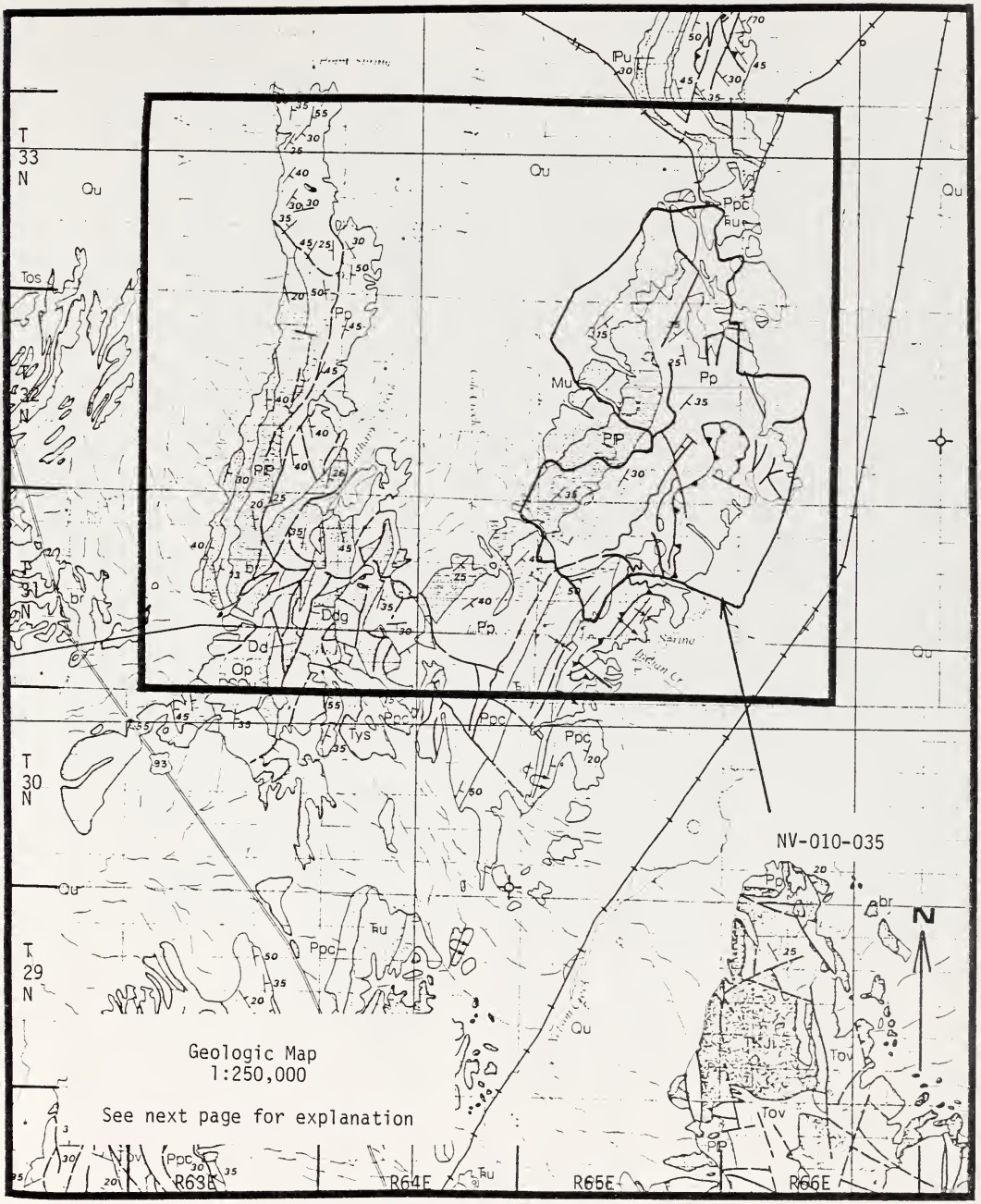
FIGURE 1. GRA INDEX MAP OF REGION 3 1:3,168,000.



Elko Sheet

South Pequop GRA NV-01

Figure 2



Howard (1978)

South Pequop GRA NV-01

Figure 3

EXPLANATION

Cenozoic Sediments

Quaternary, Undifferentiated (Qu): *Includes all sedimentary rocks and surface exposures of recent playa deposits, dune sands, lake beds, shoreline deposits and younger as well as certain older exposures of gravels and other alluvium associated with pediments and mountain streams.*

Tertiary Younger Sediments (Tys): *Sedimenetary rocks of Miocene and Pliocene age including older lake beds of the Muddy Creek Formation and Panaca Formation in Lincoln and Clark Counties; the Muddy Creek Formation in Southwestern Utah; pre-Quaternary sediments in the White River Valley; and sediments associated with ash-flow tuffs near Antelope Summit in White Pine County.*

Tertiary Sediments, Undifferentiated (Tsu): *Primarily Miocene and upper Oligocene deposits including tuffaceous sediments interbedded with ash flow tuffs, the Horse Camp Formation and various unidentified tuffs, tuffaceous shales and diatomites in Nye County; intravolcanic tuffaceous and clastic sedimentary rocks in Lincoln and Nye Counties; and conglomerates and limestones of uncertain age in the Conger-Confusion Ranges and the Cricket Mountains of Utah.*

Tertiary Older Sediments (Tos): *Includes the Sheep Pass Formation in Lincoln and Nye Counties; the Gilmore Gulch Formation in Nye County; unnamed lacustrine limestones in southern Lincoln County; older gravels, conglomerates, tuffaceous and clastic sedimentary rocks, limestones, cherts, claystones, silts, carbonaceous shales and oil shales in Elko County; and older limestones of the Illipah area and the Kinsey Canyon Formation of the Schell Creek and Grant Ranges in White Pine County.*

Cenozoic Volcanics

Quaternary Basalt (Qb): *Basalt, andesite and latite of Quaternary or late Tertiary age in Nye County.*

Tertiary Basalt (Tb): *Intermediate and basaltic lavas including the Fortification Basalt Member of the Muddy Creek Formation in Clark County; basalt flows, basaltic cinder, tuff and lava cones which are included in parts of the Banbury Formation and latite flows in Elko County; basalt flows and dikes in Lincoln County; andesite and basalt flows of various ages in North Central Nevada; and basalt and basaltic andesite flows in Southwestern Utah.*

Tertiary Volcanics, Undifferentiated (Tvu): *Early to late Tertiary volcanic rocks ranging in composition from silicic to intermediate; primarily rhyolites, dacites, quartz latite flows, ignimbrites and pyroclastics of widespread occurrence. These rocks are listed under various subdivisions in Elko, Lincoln, and Nye Counties; North Central Nevada and Southwestern Utah.*

Tertiary Older Volcanics (Tov): *Pre-Miocene volcanic rocks lithologically similar to Tertiary Volcanics, Undifferentiated (Tvu). Listed under various subdivisions in Nye County.*

Intrusives (TKJi): *Occurred from mid-Jurassic through late Tertiary. Widespread intrusions ranging in composition from granitic through gabbroic and in texture from holocrystalline to porphyritic.*

Mesozoic Sediments

Tertiary-Cretaceous Sediments (TKsu): *Continental sediments consisting of fanglomerates, clastics, tuffs and limestones. Includes the Gale Hills Formation and the Overton Fanglomerate.*

Cretaceous Sediments (Ks): *Chiefly non-marine siltstone, shale, conglomerate and limestone. Includes lower Gale Hills Formation, Thumb Formation, Baseline Sandstone, Willow Tank and Newark Canyon Formations.*

Jurassic (Ju): *Eolian cross-bedded sandstone in Utah, volcanically derived sediments, ash flows and basic lava flows in northern Elko County. Includes Navajo Sandstone, Aztec Sandstone, Frenchie Creek Formation and Bayer Ranch Formation.*

Jurassic-Triassic (JTu): *Includes Nugget and Aztec Sandstones and Chinle Formation of southern Nevada.*

Triassic (Tu): *Shallow marine sedimentary rocks including Chinle, Shinarump, Thaynes and Moenkopi Formations in the west and continental to shallow marine sediments in the east.*

Mesozoic Volcanics

Tertiary-Cretaceous Volcanics (TKvu): *Occur in Lincoln County where it covers wide areas of the Clover, Del Mar, Wilson Creek, White Rock and Mahogany Mountains.*

Paleozoic Sediments

Permian, Undifferentiated (Pu): *Shallow marine intertidal and continental sediments. Includes Gerster Formation, Plympton Formation, Kaibab Limestone, Pequop Formation, Coconino Sandstone, Arcturus Formation, Rieptown Formation, Rib Hill Sandstone, Riepe Springs Formation, Carbon Ridge Formation and Loray Limestone. With the exception of parts of White Pine County, local symbols are used to identify all Permian outcrops. In White Pine County, local symbols are used except for the Park City Group which is grouped with the Arcturus and Rib Hill Sandstones (Par). To avoid confusion, non-standard symbol used for Permian in Utah has been replaced with the standard "P".*

Pennsylvanian-Permian (PIPu): *Marine sandstone and limestone (dolomatized in places). Includes Rib Hill Sandstone, Riepe Spring Limestone and Ferguson Mountain Formation in southern Elko County; Strathearn Formation, Buckskin Mountain Formation, Beacon Flat Formation and Carlin Canyon Formation in Eureka County; Pablo Formation in Nye County; and Oquirrh Formation or group in Utah. Local symbols are used where possible.*

Pennsylvanian, Undifferentiated (IPu): *Includes Ely Limestone, Moleen and Tomera Formations. To avoid confusion, the non-standard symbol used for Pennsylvanian in Utah has been replaced by "IP".*

Mississippian Upper (Mu): *Includes Diamond Peak and Bird Spring Formations, Callville Limestone, Scotty Wash Formation, Ochre Mountain Limestone and Manning Canyon Shale in parts of Clark County. Chainman Shale is combined with Diamond Peak Formation in some parts of Utah.*

Mississippian, Chainman Shale (Mc): *Includes Mountain City Formation in Elko County and Eleana Formation in Nye County.*

Mississippian, Lower (Ml): *Includes Monte Cristo and Rogers Spring Limestones in Clark County; Joana, Mercury and Bristol Pass Limestones in Lincoln County; and Joana Limestone elsewhere.*

Mississippian-Devonian, Undfiferentiated (MDu): *Includes Rogers Spring Limestone and Muddy Peak Limestone in parts of Clark County: Joana Limestone and Pilot Shale in Elko County; Pilot Shale, Joana Limestone, Chainman Shale and Diamond Peak Formation in Eureka and White Pine Counties.*

Mississippian-Devonian, Pilot Shale (MDp): *Shown in combination with other Mississippian Formations in Clark, Elko, parts of Lincoln, Eureka and White Pine Counties.*

Devonian-Cambrian, Undifferentiated (DSO-Cu): *Undivided limestone and dolomite occurring in Lincoln County.*

Devonian-Ordovician, Undifferentiated (DSOu): *Dolomites in Elko and Nye Counties.*

Devonian, Upper (Du): *Primarily Devils Gate and Guilmette Formations. Also includes Sevy and Simonson dolomites in parts of White Pine County. Contains Guilmette, Devils Gate, Simonson and Sevy in Elko County under the heading of* Dgd. *Local symbols used where possible.*

Simonson Dolomite (Dsi): *Alternating light to dark gray fine to coarse grained dolomite. Included with other Silurian and Devonian sediments in North Central Nevada and parts of Utah. Grouped with Sevy Dolomite in parts of Clark, Elko, Eureka, Nye, and White Pine Counties.*

Sevy Dolomite (Dse): *Very light colored, dense, distinctly bedded unfossiliferous dolomite. Combined with other Devonian and Silurian sediments in parts of North Central Nevada and Utah and with the Simonson Dolomite in parts of Clark, Elko, Eureka, Nye and White Pine Counties.*

Sevy and Simonson Dolomites, combined (Dun): *Also includes the Sultan and Muddy Peak Limestones in Clark County; Nevada Formation in Elko County; Devils Gate Formation in Eureka County; Nevada Formation, Woodpecker Limestone, Oxyolk Canyon Sandstone and Rabbit Hill Formation in Nye County; Nevada Formation and Devils Gate Formation in Eureka County and the Nevada Formation in White Pine County. Local symbols are used where possible.*

Devonian, Western Facies (Dw): *A portion of the western allochthonous assemblage. Includes Woodruff Formation and Slavern Chert in Eureka County and silicious siltstone in the Cockalorum Wash area of Nye County.*

Silurian, Undifferentiated (Su): *Includes Lone Mountain and Laketown Dolomites throughout the mapping area, the Elder Sandstone and Fourmile Canyon formation in Eureka County, and the Roberts Mountain formation in Nye County. In White Pine County, the Silurian deposits are grouped with the upper Ordovician sediments under the heading of Silurian-Ordovician, Undifferentiated (SOu).*

Upper Ordovician, Undifferentiated (Oupu): *Includes Ely Springs and Fish Haven Dolomites and the Hanson Creek Formation. Local symbols are used where possible. Listed as Ordovician, Undifferentiated (Ou) in parts of North Central Nevada. In Clark County, Ely Springs Dolomite has been divided from the rest of* Oep *by the author. The Eureka Quartzite and Pogonip Group are grouped with Silurian sediments under the heading Silurian-Ordovician, Undifferentiated (SOu) in Elko County.*

Ordovician, Eureka Quartzite (Oe): *Light colored vitreous quartzite and hard sandstone. Also includes the Swan Peak Quartzite in parts of Utah. In Clark County, the Eureka Quartzite has been separated from* Oep *by the author. In parts of North Central Nevada, the Eureka Quartzite has been grouped with other Ordovician sediments under the heading of* Ou. *In White Pine County, the Eureka Quartzite has been grouped with the Pogonip Group under the heading of*

Ordovician, Pogonip Group (Op): *Limestone, silty limestone, shale and interformational conglomerates. In Clark County, the Pogonip Group has been separated from* Oep *by the author. Includes the Garden City Limesione in parts of Utah. In White Pine County, the Pogonip Group is grouped the Eureka Quartzite under the heading of* Ol.

Ordovician, Undifferentiated (Ou): *Includes the Pogonip Group, Ely Springs Dolomite, Eureka Quartzite and Comus Formation in North Central Nevada.*

Ordovician, Vinini Formation (Ovi): *Part of the western allochthonous assemblage. Includes Valmi Formation in parts of North Central Nevada. Local symbols are used where possible.*

Cambrian-Ordovician, Undifferentiated (O-Cu): *Occurs in Elko, Eureka, Nye and White Pine Counties as shale and limestone and is usually so identified when metamorphosed to phyllite. Includes the Tennessee Mountain Formation in Elko County, Board Canyon, Sequence in North Central Nevada, Windfall Formation in Nye County and the lower Ordovician and post-Dunderberg Shale in the Schell Creek Range of White Pine County. In some parts of Nye County,* O-Cu *is metamorphosed to slate and marble instead of phyllite.*

Cambrian, Upper and Middle (-Cu): *Primarily limestones, dolomites, shales and quartzites. Includes Edgemont and Peak Limestones in Elko County; Highland Peak formation, Patterson Pass Shale, Pole Canyon Limestone, Chisholm Shale and Lyndon Limestone member of the Chisholm Shale in Lincoln County; Harmony Formation, Preble Formation, Pioche Shale, Eldorado Dolomitee, Geddes Limestone, Secret Canyon, Hamberg, Dole and Dunderberg Shales, Windfall Formation, and Scott Canyon Formation in North Central Nevada; Windfall Formation, Dunderberg Shale, Tybo Shale and Lincoln Park Formation in Nye County; Notch Peak Formation, Dunderberg Shale, Orr Formation, Weeks Formation, Marjum Formation, Wheeler Shale, Swasey Formation, Whirlwind Formation, Dome Limestone, Howell Formation and Tatow Formation in Utah; and Corset Spring Shale, Notch Peak Limestone, Dunderberg Shale and Windfall Limestone in White Pine County. Metamorphosed to schist in Elko County.*

Cambrian, Lower (-Cpmp): *Primarily Prospect Mountain Dolomite and Pioche Shale. Also includes Tapeats Sandstone, Wood Canyon Formation, Lyndon Limestone, Chisholm Shale and Carrera Formation in Clark County; Sterling Quartzite and Wood Canyon Formation in parts of Lincoln County; Busby Quartzite in the Gold Hill area of Utah and the Stella Lake Quartzite in White Pine County.*

Precambrian

Precambrian Sediments (p-Cs): *Includes the Johnnie Formation, Sterling Quartzite and some metamorphics in Clark County; Johnnie Formation and lower units of Prospect Mountain Quartzite in Lincoln County; McCoy Creek Group in Elko County; and the McCoy Creek Group excluding the Stella Lake Quartzite in White Pine County.*

Precambrian Intrusives (p-Ci): *Includes the Gold Butte Granite in Clark County and other undifferentiated igneous and metamorphic rocks, primarily granites and pegmatites.*

II. GEOLOGY

The South Pequop GRA lies in the Basin and Range geomorphic province in southeastern Elko County. The GRA covers the northeast-trending southern part of the Pequop Range, Spruce Mountain and the north-trending Spruce Mountain Ridge, and the valley between the two ranges.

The tectonic highlands form a roughly U-shaped complex of complexly folded, thrusted, and faulted Paleozoic sediments of the eastern carbonate facies. The Spruce Mountain area and the southeast portion of the Pequop Range have been mapped in some detail by Harlow (1956) and Snelson (1955) respectively, but the majority of the area has not received in-depth study.

1. PHYSIOGRAPHY

The South Pequop GRA lies within the Basin and Range province in southeastern Elko County, Nevada. The GRA includes Spruce Mountain Ridge, Spruce Mountain, Coyote Basin area, and the southern Pequop Mountains, which together form a U-shaped complex of faulted Paleozoic sediments. WSA 010-035 covers a portion of the southern Pequop Mountains, a northeasterly-trending block of Paleozoic and Mesozoic sediments that have been deformed by thrusting and normal faults.

The topography in the area is rugged with the highest elevation of 10,262 feet occurring at Spruce Mountain in the southwest corner of the GRA.

Drainage of the study area is internal with streams from the mountains discharging into the following adjacent valleys listed from west to east: Clover Valley, Independence Valley, and Steptoe Valley, all of which have elevations of about 5,500 feet.

2. ROCK UNITS

The oldest rock unit in the study area is the Ordovician Pogonip group which consists of limestone and minor silty shale units. The Eureka Quartzite, a light gray compact quartzite, conformably overlies the Pogonip (Harlow, 1956). A sequence of undivided Ordovocian-Devonian dolomites and limestones are the next youngest rock units.

In fault contact with the above mentioned older sediments is a Mississippian(?)-Pennsylvanian(?) shale unit with minor conglomerate and quartzite beds. An unnamed sequence of Mississippian(?)-Pennsylvanian limestone units with minor siltstone and chert was deposited next (Harlow, 1956).

An undivided sequence of limestone, siltstone and sandstone was deposited next during Pennsylvanian-Permian time. The Kaibab Formation, consisting of grey limestone and thin chert layers, was laid down during the Permian (Snelson, 1955). The Phosphoria Formation was then deposited, consisting of gray limestones, oolitic phosphate, chert and shales. Hope and Coates (1976) include this unit as part of their generalized Park City Group.

The lower Triassic Dinwoody Formation, an interbedded unit of green shales and brown limestone marks a distinct lithological change from the older gray limestones. Above this the lower Triassic Thaynes Formation is divided into two interbedded sequences of green shales and limestones separated by a red shale unit, and unconformably overlies the older sediments.

According to Schrader (1931) igneous rocks in the Spruce Mountain area are granite, dacite, and lamprophyre. These intrusions are poorly exposed, and the specific ages of the igneous bodies have not been determined. No intrusive rocks are known in the South Pequop Range (Hope and Coates, 1976), in which WSA NV 010-035 lies.

The Humboldt Formation, which consists of crystal vitric tuffs, siltstone, sandstone, and conglomerates, was deposited during the Lower Pliocene.

The youngest rock unit is a welded tuff whose specific age has not been determined, but is estimated by Harlow (1956) to be one and one-half to two million years old.

3. STRUCTURAL GEOLOGY AND TECTONICS

The structure in the South Pequop area is extremely complex and not completely understood. Thrusting, folding and normal and transverse faulting in the southern Pequop Range and the Spruce Mountain area have been generally described by Snelson (1955) and Harlow (1956), respectively, however, no exact ages have been determined for the various structural events that have affected the area.

The Spruce Mountain area is atypical of Basin and Range structure in that no direct bedrock evidence of high angle range front faulting which would account for the height of the range has been found. Harlow (1956) suggests that Spruce Mountain and the ridge extending from it to the north were formed by anticlinal arching rather than Basin and Range faulting.

Pre-Tertiary rocks of the Spruce Mountain area are separated into two units by a major thrust fault of unknown displacement. Movement on this thrust has been from east to west with upper plate Pennsylvanian-Permian rocks riding over older Paleozoic sediments. The east-west trending trace of

the Spruce Mountain thrust is exposed southwest of the south peak of Spruce Mountain.

In the South Pequop Range large scale folding with a northeasterly trend has produced a southwest plunging syncline over eight miles long and an adjacent anticline to the east. The anticline was partly overturned and was thrust westward over a portion of the syncline (Snelson, 1955). A homocline lies west of the syncline.

A group of northwest-trending transverse strike-slip faults occur along the southernmost boundary of the range, and may in part be responsible for the southern termination of the Pequop Mountains (Snelson, 1955).

Normal faults in the study area generally have a northerly trend and often are parallel to bedding. Maximum displacement of these faults is generally only several hundred feet.

4. PALEONTOLOGY

Pennsylvanian and Permian marine sediments form the dominant units of the South Pequop GRA. Limited outcrops of Mississippian (Joana Limestone and Chainman Shale) form the western margins of Spruce Mountain Ridge and the Pequop Range. The majority of the elevated parts of this GRA are essentially one large but discontinuous paleontological resource area (E.C. Wilson, L.A. County Museum Nat. History, pers. comm.). Marine faunas are dominated by brachiopods, corals and mollusks. Specific localities are scattered over a wide area and are not noted in this report due to lack of specific data. It is suggested that the records of the Los Angeles County Museum of Natural History, Museum of Paleontology at U.C. Berkeley, and the U.S. Geological Survey would need to be searched for precise locality data. Steele (1960) and Coogan (1964) are primary references for the faunas and biostratigraphic relationships of this area.

5. HISTORICAL GEOLOGY

Throughout the Paleozoic marine sediments of the eastern carbonate facies were deposited in the area. A period of non-deposition possibly accompanied by sub-aerial erosion and/or submarine erosion occurred after Guadalupian time late in the Permian. Subsidence and deposition resumed during Lower Triassic time with a distinct lithological change -- the grey Permian limestones were overlain by green shales and reddish brown limestones.

Sometime during the Mesozoic high angle faulting followed by igneous intrusion occurred. Large scale overthrusting with associated tear faulting subsequently displaced Paleozoic sediments in the area (Snelson, 1955). Gentle folding coeval

with or slightly before high angle normal faulting formed much of the present day topography sometime during the late Tertiary.

Deposition of welded tuff occurred sometime during the late Tertiary(?)-Early Quaternary(?) subsequent to the above described tectonic events.

III. ENERGY AND MINERAL RESOURCES

A. METALLIC MINERAL RESOURCES

1. Known Mineral Deposits

The Spruce Mountain district is in the southwest corner of the South Pequop Range GRA. It is credited with nearly $3 million production in lead, silver, gold, copper and zinc from 1869 to 1949 (Granger, and others, 1759). There has probably been little production since 1949.

There are no known metallic mineral deposits in WSA NV 010-035.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are no known metallic mineral prospects, occurrences or mineralized areas in the WSA.

3. Mining Claims

There are patented and unpatented mining claims in and around the Spruce Mountain, but there are no patented or unpatented claims in WSA NV 010-035.

4. Mineral Deposit Types

The deposits of the Spruce Mountain district occur as mesothermal replacement bodies in carbonate rocks, bedded in some places or following seams and fractures or contacts with igneous rocks. There are some fissure vein deposits, but overall the bedded deposits have been most productive (Granger, and others, 1957).

5. Mineral Economics

The deposits in the Spruce Mountain district were small by modern standards -- the several mines and numerous orebodies produced only about 105,000 tons of ore (Granger, and others, 1957). Such orebodies in themselves would be of little interest to a major mining company. Their existence suggests the possible presence of larger replacement deposits that have not yet been found, and also the possible presence of a porphyry copper deposit somewhere in the district. The small orebodies that have been mined, if found today with their high grade, could be mined profitably by very small organizations during times of high metal prices.

B. NONMETALLIC MINERAL RESOURCES

1. Known Mineral Deposits

No nonmetallic mineral deposits are known in the GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

Phosphate rock is known to occur extensively in the southern part of WSA NV 010-035 in formations equivalent to the Phosphoria Formation. Granger, and others, (1957), specify an 84-foot thickness of phosphatic rock near the bottom of the Permian Gerster Formation in Sec. 25, T 31 N, R 64 E, a little southwest of the WSA. Wayland (attachment to 1962 USGS memo, in GRA file) lists a couple of dozen sections in the Southern Pequop Mountains that are "areas of prospective phosphate lands"; this list was used to delineate the area of phosphatic beds (N1-3D) outlined on the Nonmetallic Mineral Occurrences map accompanying the present report, which extends well into the southern part of the WSA. Hope and Coates (1976) list several Permian formations as having phosphate-bearing beds but they are probably all in essence a single formation, which in the South Pequop Range is part of the generalized Park City Group. The group is exposed mostly in the area outlined from Wayland's list of prospective phosphate bearing sections, but Hope and Coates (1976) show scattered small areas of the Park City Group farther north (N2-2B, N3-2B), as outlined on the Nonmetallic Minerals Occurrences map. These areas too, have potential for phosphate rock.

3. Mining Claims, Leases and Material Sites

There are no mining claims, patented or unpatented, in WSA NV 010-035.

Tingley's 1979 CRIB report (see GRA file) specifies prospecting permits (USGS conservation Division) that were in effect from 1965 through 1972. Nine trenches were cut and several holes drilled in the Plympton Formation (one of those named as phosphate-bearing by Hope and Coates (1976)), probably the same as Granger's (1957) Gerster Formation, and part of Hope and Coates (1976) Park City Group. No mineral leases are known presently in the GRA.

4. Mineral Deposit Types

The phosphatic occurrences are sedimentary beds in which the phosphate minerals were deposited chemically from the sea at the same time as the accompanying limestone. This is a significant point, since it means that phosphate

probably occurs in the same bed over a very extensive area. Even so, the thickness of the phosphatic bed, and the grade of phosphate within it, may vary from place to place depending upon local variations of the sea water and the sea bed at the time the rocks were being deposited. Tingley (1979 CRIB report in GRA file) says that the 1965-72 work explored the phosphatic beds at ten to fifteen localities along a ten-mile length of outcrop, and that the greatest thickness encountered was 32.5 feet averaging 10.5% P_2O_5, while the highest grade was six feet averaging 20.2% P_2O_5.

5. Mineral Economics

Large quantities of phosphate rock are known in the world, and one of the major resources is the large area of outcrop of the Phosphoria Formation in the western United States -- the formation once covered 135,000 square miles in Montana, Idaho, Wyoming, Utah and Nevada (Emigh, 1975). The phosphate-bearing beds in the South Pequop Range, though they have different names, are part of this unit. Smith (1976) states that in phosphate mining areas, high-grade ore is that containing more than 31% P_2O_5 and is mined in beds from two feet to seven feet in thickness, while low-grade ore is that containing more than 24% P_2O_5 and is mined in 40-foot beds. The occurrences known in the south Pequop Range are, according to the available information (Tingley 1979 CRIB report), either fairly thick but rather low grade, or fairly good grade but rather thin. Nonetheless, not enough is known about the occurrences to conclude that they are not mineable. It is possible that in some places the nature of the occurrences is such that production costs would be low enough to offset the relative thinness of the beds or lowness of the grade.

C. ENERGY RESOURCES

Uranium and Thorium Resources

1. Known Mineral Deposits

There are no known uranium or thorium deposits in the WSA or GRA.

2. Known Prospects, Mineral Occurrences and Mineralized Areas

There are no known uranium or thorium occurrences in the WSA or GRA.

3. Mining Claims

There are no known uranium or thorium claims or leases in the WSA or GRA.

4. Mineral Deposit Types

A discussion of mineral deposit types is not possible due to the lack of uranium and thorium deposits in the WSA and GRA.

5. Mineral Economics

Uranium and thorium appear to be of very little economic value in the WSA or GRA due to the lack of occurrences of these elements.

Oil and Gas Resources

1. Known Oil and Gas Deposits

There are no known oil and gas deposits in the GRA.

2. Known Prospects, Oil and Gas Occurrences and Petroliferous Areas

There are no known or oil seeps in the GRA or bordering areas, although there are three exploratory wells in the immediate area. These are Shell Goshute No. 1 (#1 on the Oil and Gas Land Classification and Mineral Occurrence Map) drilled to 5,529 feet in 1976, Gulf Dolly Varden No. 1 (#2) drilled to 3,158 feet in 1953, and the Depco Ventosa No. 42-13 (#3) which bottomed at 6,073 feet in 1979 (Lintz, 1957; Garside and others, 1977; and Nevada Bureau of Mines and Geology, 1982).

3. Oil and Gas Leases

Approximately thirty sections in the WSA and most of area at lower elevations in the GRA are leased for oil and gas.

4. Oil and Gas Deposit Types

Oil deposits that have been found and developed, and those that are being explored for in the Basin and Range to date, have been limited to the Upper Paleozoic section of the Miogeosyncline and the Tertiary section of the intermontane basins. The source rocks are assumed to be in Paleozoic horizons, such as the Mississippian Chainman

Shale, and perhaps also Tertiary section.

The reservoirs at the Trap Spring and Eagle Springs oil fields in Railroad Valley are the Oligocene Garrett Ranch volcanics or equivalent, which produce from fracture porosity; or the Eocene Sheep Pass Formation, a freshwater limestone. Minor production has been recorded from the Ely(?) Formation of Pennsylvanian age at Eagle Springs. It may be that production also comes from other units in the Tertiary or Paleozoic sections in the Blackburn oil field in Pine Valley or the Currant and Bacon Flat oil fields in Railroad Valley.

5. Oil and Gas Economics

The low level of production from Nevada Basin and Range oil fields, which are remote from existing pipelines, existing refineries and consuming areas, necessitates the trucking of the crude oil to existing refineries in Utah, California and Nevada. Since the discovery of oil in Nevada in 1953, the level of production has fluctuated. Factors which have affected the production from individual wells are: reservoir and oil characteristics; Federal regulations; productivity; environmental constraints; willingness or ability of a refiner to take certain types of oil; and of course, the price to the producer, which is tied to regional, national and international prices.

Geothermal Resources

1. Known Geothermal Deposits

There are no known geothermal deposits in the GRA.

2. Known Prospects, Geothermal Occurrences, and Geothermal Leases

There are no known prospects, occurrences or thermal areas in the GRA or immediate vicinity.

3. Geothermal Leases

No Federal geothermal leases are present in the GRA or vicinity.

4. Geothermal Deposit Types

Geothermal resources are hot water and/or steam which occurs in subsurface reservoirs or at the surface as springs. The temperature of a resource may be about 70°F (or just above average ambient air temperature) to well above 400°F in the Basin and Range province.

The reservoirs may be individual faults, intricate fault-fracture systems, or rock units having intergranular permeability -- or a combination of these. Deep-seated normal faults are believed to be the main conduits for the thermal waters rising from thousands of feet below in the earth's crust.

The higher temperature and larger capacity resources in the Basin and Range are generally hydrothermal convective systems. The lower temperature reservoirs may be individual faults bearing thermal water or lower pressured, permeable rock units fed by faults or fault systems. Reservoirs are present from the surface to over 10,000 feet in depth.

5. Geothermal Economics

Geothermal resources are utilized in the form of hot water or steam normally captured by means of drilling wells to a depth of a few feet to over 10,000 feet in depth. The fluid temperature, sustained flow rate and water chemistry characteristics of a geothermal reservoir determine the depth to which it will be economically feasible to drill and develop each site.

Higher temperature resources (above 350°F) are currently being used to generate electrical power in Utah and California, and in a number of foreign countries. As fuel costs rise and technology improves, the lower temperature limit for power will decrease appreciably -- especially for remote sites.

All thermal waters can be beneficially used in some way, including fish farming (68°F), warm water for year around mining in cold climates (86°F), residential space heating (122°F), greenhouses by space heating (176°F), drying of vegetables (212°F), extraction of salts by evaporation and cyrstallization (266°F), and drying of diatomaceous earth (338°F).

Unlike most mineral commodities remoteness of resource location is not a drawback. Domestic and commercial use of natural thermal springs and shallow wells in the Basin and Range province is a historical fact for over 100 years.

Development and maintenance of a resource for beneficial use may mean no dollars or hundreds of millions of dollars, depending on the resource characteristics, the end use and the intensity or level of use.

D. OTHER GEOLOGICAL RESOURCES

No other geological resources are known or indicated in WSA NV 010-035. There is no reason to suspect there might be coal resources.

E. STRATEGIC AND CRITICAL MINERALS AND METALS

A list of strategic and critical minerals and metals provided by the BLM was used as a guideline for the discussion of strategic and critical materials in this report.

The Stockpile Report to the Congress, October 1981-March 1982, states that the term "strategic and critical materials" refers to materials that would be needed to supply the industrial, military and essential civilian needs of the United States in sufficient quantities to meet such need. The report does not define a distinction between strategic and critical minerals.

No strategic or critical minerals or metals are thought to be in WSA NV 010-035.

IV. LAND CLASSIFICATION FOR G-E-M RESOURCES POTENTIAL

The map by Hope and Coates (1976) provides good geologic coverage of the GRA and the WSA at a rather small scale. We found no better maps. There is fairly abundant, though not complete, data on phosphate occurrences in the WSA but no information at all concerning any other mineral occurrences. The quantity and quality of geological data available are high. The quantity and quality of data concerning phosphates are moderate, while the quantity of information concerning possible other minerals is zero. The level of confidence in the geological data and data concerning phosphate occurrences is high but the level of confidence concerning mineral occurrences other than phosphates is necessarily zero.

Land classification areas are numbered starting with the number 1 in each category of resources. Metallic mineral land classification areas have the prefix M, e.g. M1-4D. Uranium and thorium areas have the prefix U. Nonmetallic mineral areas have the prefix N. Oil and gas areas have the prefix OG. Geothermal areas have the prefix G. Sodium and potassium areas have the prefix S. The saleable resources are classified under the nonmetallic mineral resource section. Both the Classification Scheme, numbers 1 through 4, and the Level of Confidence Scheme, letters A, B, C, and D, as supplied by the BLM are included as attachments to this report. These schemes were used as strict guidelines in developing the mineral classification areas used in this report.

Land classifications have been made here only for the areas that encompass segments of the WSA. Where data outside a WSA has been used in establishing a classification area within a WSA, then at least a part of the surrounding area may also be included for clarification. The classified areas are shown on the 1:250,000 mylars or the prints of those that accompany each copy of this report.

In connection with nonmetallic mineral classification, it should be noted that in all instances areas mapped as alluvium are classified as having moderate favorability for sand and gravel, with moderate confidence, since alluvium is by definition sand and gravel. All areas mapped as principally limestone or dolomite have a similar classification since these rocks are usable for cement or lime production. All areas mapped as other rock, if they do not have specific reason for a different classification, are classified as having low favorability, with low confidence, for nonmetallic mineral potential, since any mineral material can at least be used in construction applications.

1. LOCATABLE RESOURCES

a. Metallic Minerals

WSA NV 010-035

M1-1B. This classification area covers the entire WSA. No occurrences of metallic minerals are known in the WSA. Most of the sedimentary formations are not particularly favorable for mineralization on a regional scale, and there are no intrusive rocks that might serve as source rocks for hydrothermal mineralization. These are the reasons the WSA is classified as having no known favorability for metallic mineralization, with a low level of confidence.

b. Uranium and Thorium

WSA NV 010-035

U1-1A. This land classification covers most of the WSA and a U-shaped area in the center of the GRA. The area is covered by Paleozoic-Mesozoic carbonates, shales and sandstones with very minor exposures of intrusive igneous rocks and silicic tuffs. The area appears to have very low favorability with very low confidence for uranium deposits due to the very limited exposures of potential source rocks for fracture-fill uranium deposits.

The area has very low favorability, with very low confidence for thorium deposits due to the apparent lack of suitable source rocks.

U2-1A. This land classification covers small areas of the margins of the WSA and the western, north-central and the eastern parts of the GRA. The areas are covered by Quaternary alluvium and appear to have very low uranium favorability at a very low level of confidence due to lack of source rocks, such as tuffs or rhyolite, which are necessary to produce sandstone-type deposits.

The areas have very low favorability with very low confidence for thorium deposits due to the apparent lack of suitable source rocks such as granites or pegmatites.

c. Nonmetallic Minerals

WSA NV 010-035

N1-3D. This classification area covers the southern one-quarter of the WSA. It is part of the larger area that Wayland (1962 memo in GRA file) defined as having prospective phosphate lands. It also includes the major

outcrop area of the phosphate-bearing Park City Group (Hope and Coates, 1976), as well as apparently including the area of at least some of the 1965-1972 drilling and pitting described by Tingley (CRIB report in GRA file). The abundant evidence of the presence of phosphate rock (but without production) is the reason for the moderately favorable classification and the high level of confidence in this classification.

N2-2B. This classification area covers a northern extension of N1-3D, not part of Wayland's area, in which Hope and Coates (1976) show an extension of the Park City Group and presumably of the phosphate-bearing beds in it. The presence of the Park City Group is the reason for the low favorability assigned to the area, while the low level of confidence stems from the fact that the phosphatic beds may not be present.

N3-2B. This classification area covers part of the northeast corner of the WSA. Here, Hope and Coates (1976) show several small outcrop areas of Park City Group rocks. The rationale for the low favorability and low level of confidence is the same as for N2-2B.

N4-3C. This classification area covers the central part of the WSA. There is no known potential here for phosphates since the Park City Group is not present, but most of the rocks are limestones or dolomites which are usable for the production of lime, cement and other materials. The known presence of these rocks is the reason for the moderate favorability and moderate level of confidence. Strictly speaking, the same classification and confidence level for the same reason should also be applied to classification areas N1, N2 and N3, since the rocks in them also are largely carbonate rocks.

N5-3C. This classification area covers much of the eastern edge of the WSA. Here Quaternary alluvium, which by definition contains sand and gravel, has been mapped. Its presence is the reason for the classification of moderate favorability. The level of confidence is only moderate because the quality of the sand and gravel at any particular point is unknown.

N6-3C. This classification area covers parts of the eastern edge of the WSA. Again, Quaternary alluvium is mapped here, and the rationale for the classification and level of confidence is the same as for N5-3C.

2. LEASABLE RESOURCES

a. Oil and Gas

WSA NV 010-035

OG1-2A. This classification covers the entire WSA which is underlain by Upper Paleozoic sediments and Quaternary alluvial cover in the valleys. Although the Shell, Gulf and Depco wells had no reported shows, leasing and exploration activity continue at a fairly high level. Approximately one-half of the WSA is under lease, including some portions at higher elevations.

Oil has been recovered in Upper Paleozoic Pennsylvanian (Ely Formation?) at the Eagle Springs oil field in Railroad Valley. There are other potential reservoirs at depth, as well as the Mississippian Chainman Shale which is a potential source rock. Fault dislocations of hundreds or thousands of feet are normal in areas such as the WSA. It is possible that favorable source and reservoir structual relationships are present beneath the WSA.

b. Geothermal

WSA NV 010-035

G1-2A. This WSA is well within the Basin and Range Province which has hundreds of geothermal resource areas distributed throughout all of Nevada's counties. Deep-seated normal faults similar to those which act as conduits for these systems are present in the WSA. Additional drilling in this area could possibly discover thermal water that could be beneficially used for its heat.

c. Sodium and Potassium

WSA NV 010-035

S1-1D. This classification area covers the entire WSA. There is no known favorability for sodium or potassium, and no reason to expect any favorability. No map is presented for sodium and potassium.

3. SALEABLE RESOURCES

Saleable resources are considered in the section on nonmetallic minerals.

V. RECOMMENDATIONS FOR ADDITIONAL WORK

1. Using existing geologic mapping as a base, the phosphatic beds should be mapped throughout WSA NV 010-035 on a scale of at least 1:24,000 and sampled where possible. The objective of this is to make a rough estimate of the size and grade of the phosphate resource present. If available topographic mapping is suitable, a rough estimate should be made of the amount of phosphate-bearing material that might be amenable to open pit mining.

2. A geochemical sampling program, of at least sediments in streams and washes around the range front, should be undertaken to replace the total lack of information concerning mineral occurrences in or near the WSA.

VI. REFERENCES AND SELECTED BIBLIOGRAPHY

Burchfiel, B. C., and Davis, G. A., 1971, Nature of Paleozoic and Mesozoic thrust faulting in the Great Basin area of Nevada, Utah, and southeastern California: Geol. Soc. America Abstracts with Programs, v. 3, no. 2, p. 88-90.

Coogan, A. H., 1964, Early Pennsylvanian history of Ely basin, Nevada: Am. Assoc. Petroleum Geologists Bull., v. 48, no. 4, p. 487-495.

Eardley, A. J., 1947, Paleozoic Cordilleran geosyncline and related orogeny: Jour. Geology, v. 55, p. 309-342.

Emigh, G. D., 1975, Phosphate rock, Lefond, editor, in Industrial minerals and rocks: American Institute of Mining, Metallurgical and Petroleum Engineers. Summary of occurrence, production and uses of phosphates.

Garside, L. J., 1973, Radioactive mineral occurrences in Nevada: Nevada Bureau of Mines and Geol., Bull. 81.

Garside, L. J., and Schilling, J. H., 1979, Thermal waters of Nevada: Nevada Bur. of Mines and Geol. Bull. 91.

Garside, L. J., Weimer, B. S. and Lutsey, I. A., 1977, Oil and gas developments in Nevada, 1968-1976: Nevada Bur. of Mines and Geol. Rept. 29.

Granger, A. E., Bell, M. M., Simmons, G. C., and Lee, F., 1957, Geology and mineral resources of Elko County, Nevada: Nevada Bureau of Mines Bull. 54. Useless for South Pequop area except for mention on p. 14 of 84-foot thick unit with phosphatic shale.

Harlow, G. R., 1956, The stratigraphy and structure of the Spruce Mountain area, Elko County, Nevada: M. S. Univ. of Washington, 1956. Map scale 1:31,680.

Hope, R. A., and Coates, R. R., 1976, Preliminary geologic map of Elko County, Nevada: U. S. Geol. Survey Open-file Map 76-779, scale 1:100,000. Good geologic mapping at a rather small scale.

Howard, E. L., ed., 1978, Geologic map of the Eastern Great Basin, Nevada and utah; Terra Scan Group Ltd.

Lintz, J. L., Jr., 1957, Nevada oil and gas drilling data, 1906-1953: Nevada Bur. Mines Bull. 52.

Nevada Bureau of Mines and Geology, 1982, List of wells drilled for oil and gas 1 January 1977 through the present (November 8, 1982): Nevada Bur. of Mines and Geol. List L-4.

Nevada Bureau of Mines and Geology Oil and Gas Files, 1982.

Schrader, F. C., 1931, Spruce Mountain district, Elko County, and Cherry Creek (Egan Canyon) district, White Pine County, Nevada: Nevada Bur. Mines Bull. 14.

Smith, 1976, Mineral resources of Elko County: U. S. Geol. Survey Open-file Rept. 76-56, 194 p.

Snelson, S., 1955, The geology of the southern Pequop Mountains in Elko County, northwestern Nevada: M. S., Univ. of Washington. Map scale 1:125,000.

Steele, Grant, 1959, Stratigraphic interpretation of the Pennsylvanian-Permian systems of the eastern Great Basin: Washington Univ., Seattle Ph.D. thesis, 294 p.

_____, 1960, Pennsylvanian-Permian stratigraphy of east-central Nevada and adjacent Utah, in Geology of east-central Nevada: Intermountain Assoc. Petroleum Geologists, 11th Ann. Field Conf., 1960 Guidebook, p. 91-113.

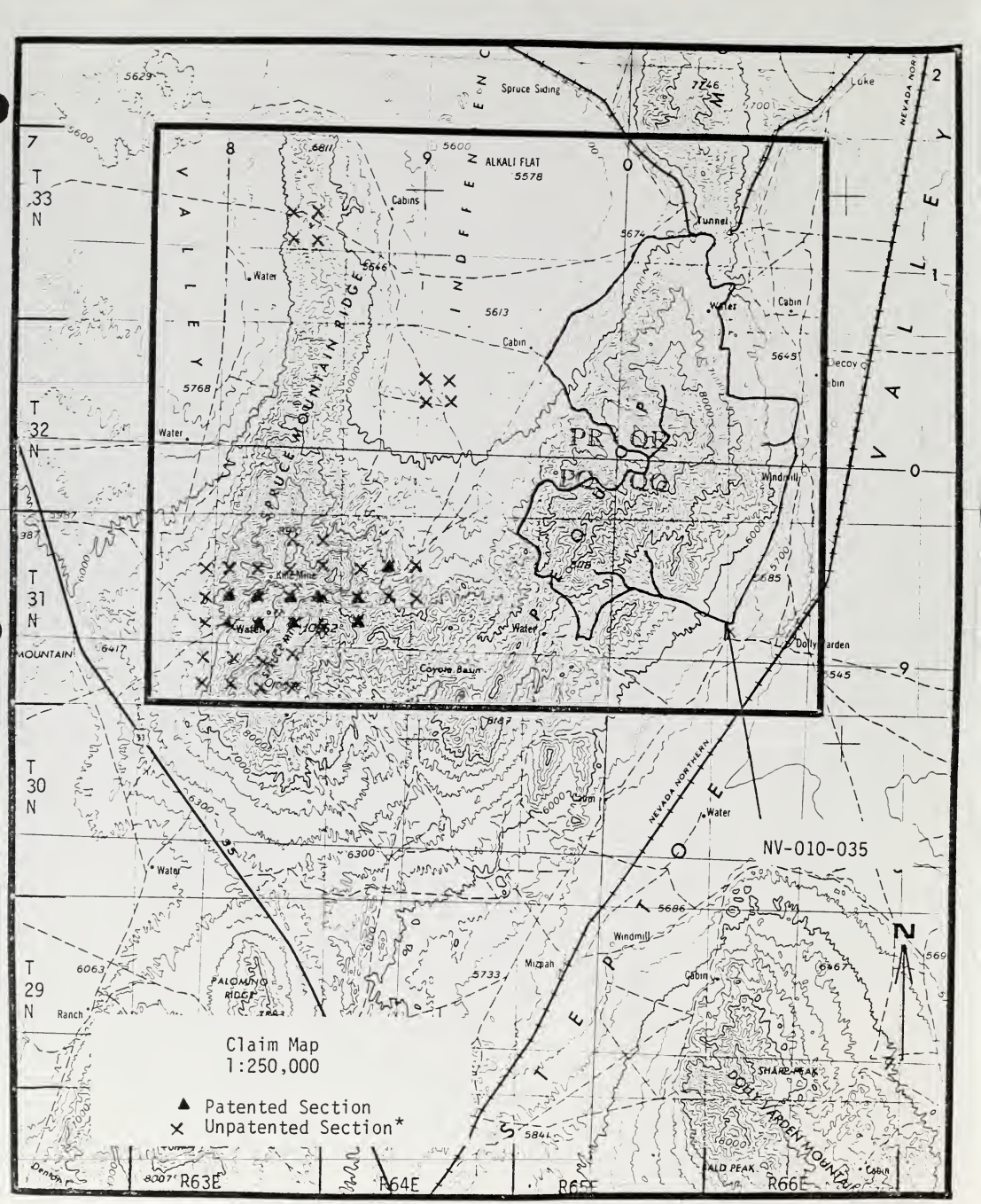
Stewart, J. H., 1980, Geology of Nevada -- a discussion to accompany the geologic map of Nevada: Nevada Bur. of Mines and Geol. Special Publication 4.

Stewart, J. H., and Carlson, J. E., 1978, Geologic map of Nevada: U. S. Geol. Survey in cooperation with Nevada Bureau of Mines and Geology.

TerraScan Group Ltd, 1978, Geologic map of the eastern Great Basin. Map at scale of 1:250,000. This map is used for the geologic map in this report because it is at the appropriate scale, though it is not as detailed as that of Hope and Coates (1976).

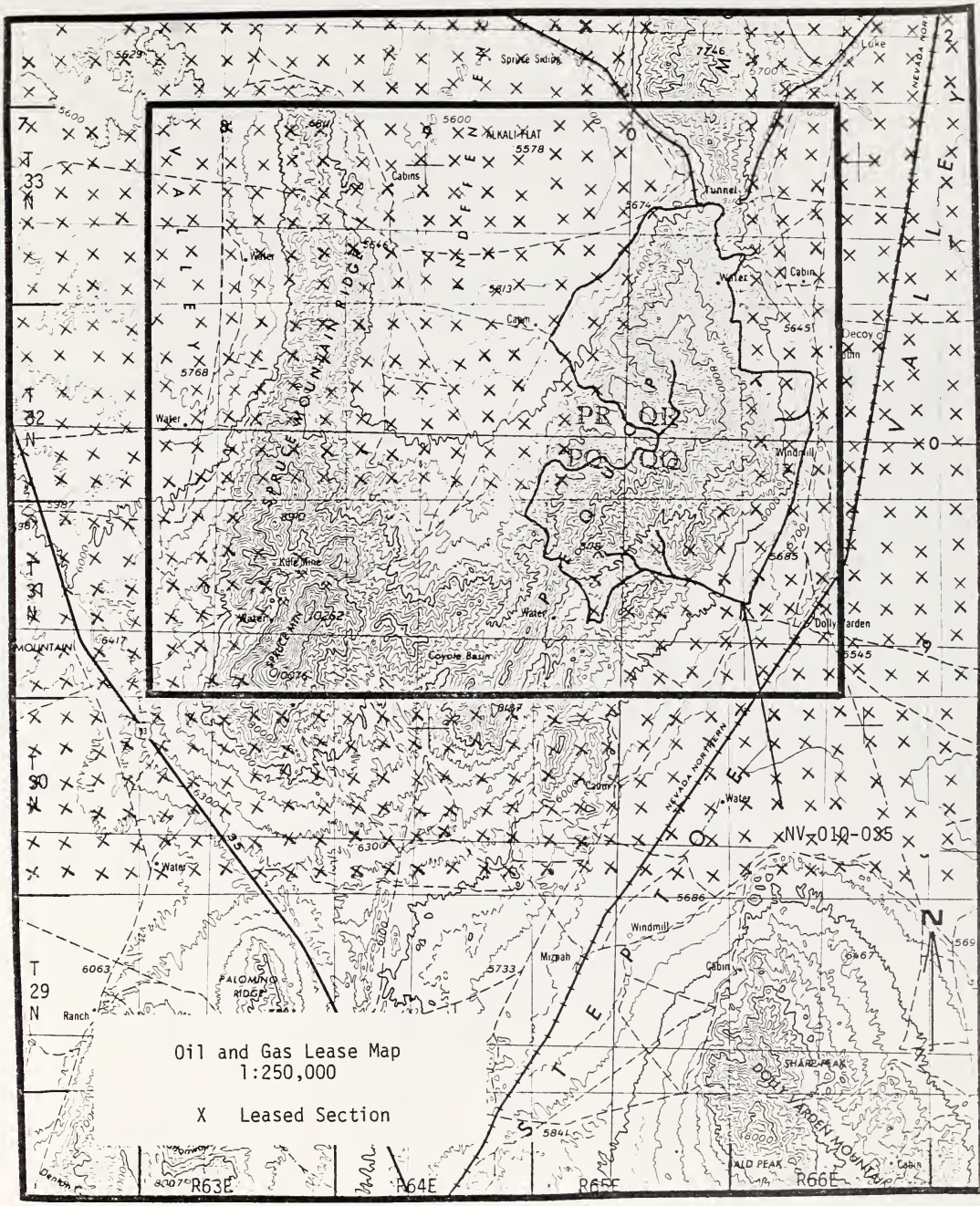
Tingley, J. C., 1979, CRIB Report form: in GRA file. Summary of information on phosphate exploration in South Pequop Range.

Wayland, R. G., 1962, Memo to Chief, Branch of Mineral Classification (presumably U. S. Geol. Survey), Estimated area of prospective phosphate lands, Nevada. Descriptions of phosphate occurrences, and list of sections considered prospective for phosphates, including South Pequop area.

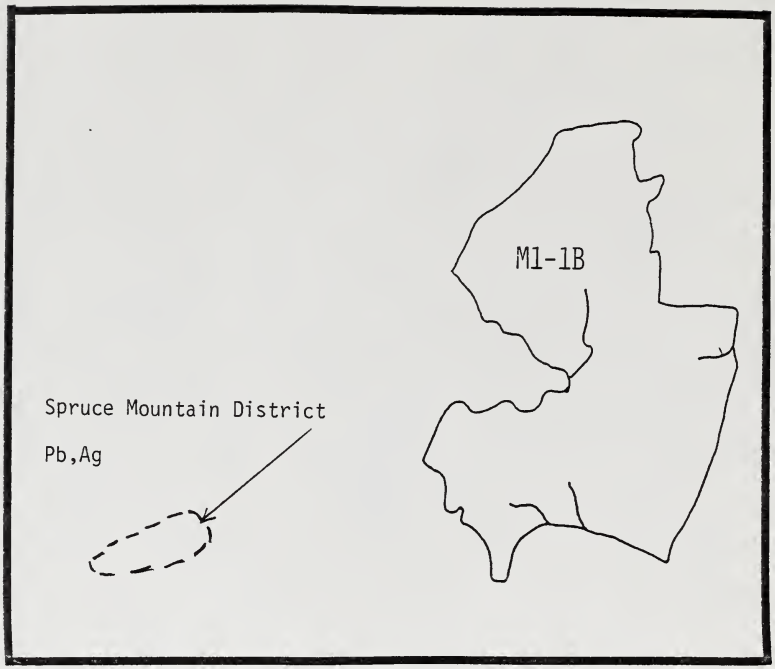


*X denote one or more claims per section

South Pequop GRA NV-01



South Pequop GRA NV-01



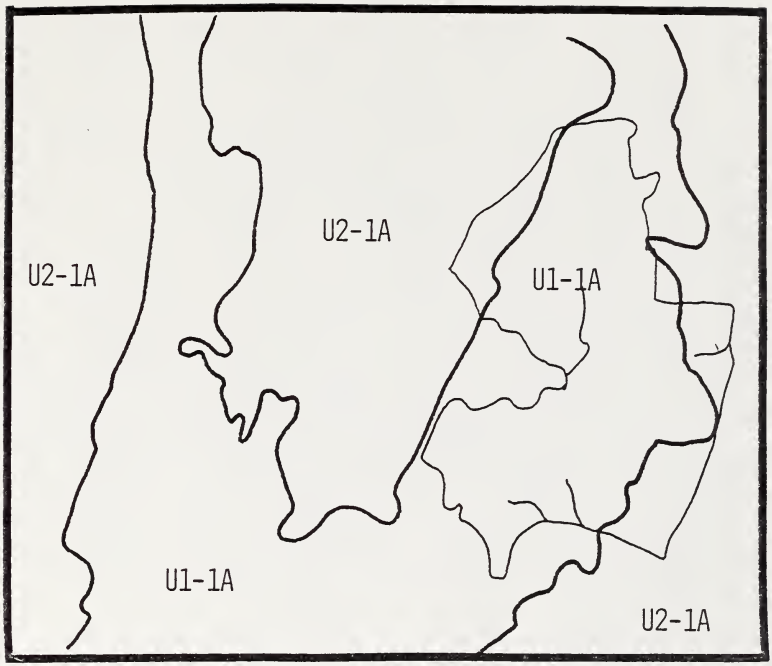
EXPLANATION

---- Mining District, commodity

——— Land Classification and WSA boundary

Land Classification - Mineral Occurrence Map/Metallics

South Pequop GRA NV-01
Scale 1:250,000



EXPLANATION

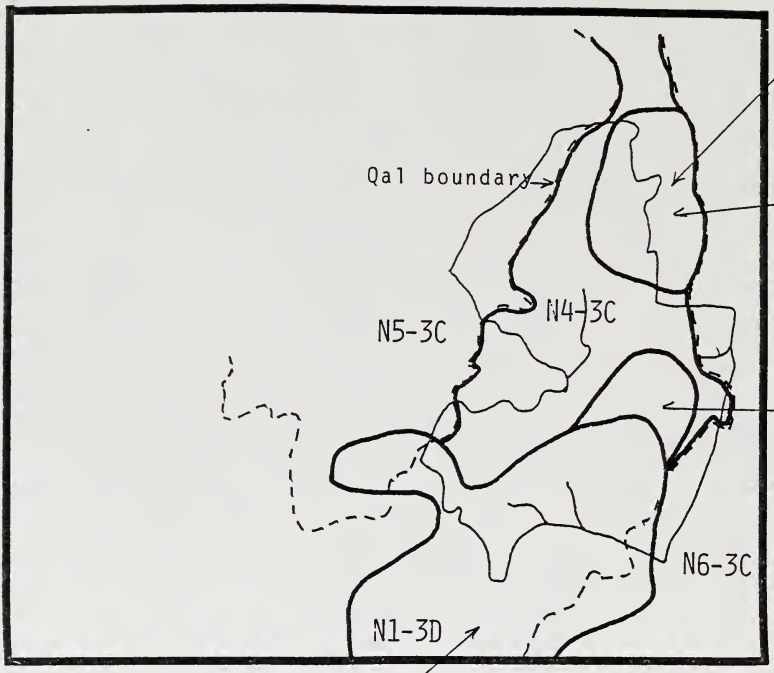
Land Classification Boundary

WSA Boundary

Land Classification - Mineral Occurrence Map/Uranium

South Pequop GRA NV-01

Scale 1:250,000



EXPLANATION

Land Classification Boundary

WSA Boundary

Land Classification - Mineral Occurrence Map/Nonmetallics

South Pequop GRA NV-01
Scale 1:250,000

3.

1.

2.

EXPLANATION

1. Reference location (see text)

Dry Hole

WSA and Land Classification Boundary

Land Classification - Mineral Occurrence Map/Oil and Gas

South Pequop GRA NV-01
Scale 1:250,000

EXPLANATION

—— WSA Boundary and Land Classification Boundary

Land Classification - Mineral Occurrence Map/Geothermal

South Pequop GRA NV-01
Scale 1:250,000

LEVEL OF CONFIDENCE SCHEME

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVELY MINIMAL TO SUPPORT TO REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

MAJOR STRATIGRAPHIC AND TIME DIVISIONS IN USE BY THE U.S. GEOLOGICAL SURVEY

Erathem or Era	System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years
Cenozoic	Quaternary	Holocene	
		Pleistocene	2-3 [1]
	Tertiary	Pliocene	12 [1]
		Miocene	26 [2]
		Oligocene	37-38
		Eocene	53-54
		Paleocene	65
Mesozoic	Cretaceous [4]	Upper (Late) Lower (Early)	136
	Jurassic	Upper (Late) Middle (Middle) Lower (Early)	190-195
	Triassic	Upper (Late) Middle (Middle) Lower (Early)	225
Paleozoic	Permian [4]	Upper (Late) Lower (Early)	280
	Carboniferous Systems: Pennsylvanian [4]	Upper (Late) Middle (Middle) Lower (Early)	
	Carboniferous Systems: Mississippian [4]	Upper (Late) Lower (Early)	345
	Devonian	Upper (Late) Middle (Middle) Lower (Early)	395
	Silurian [4]	Upper (Late) Middle (Middle) Lower (Early)	430-440
	Ordovician [4]	Upper (Late) Middle (Middle) Lower (Early)	500
	Cambrian [4]	Upper (Late) Middle (Middle) Lower (Early)	570
Precambrian [3]		Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	3,600+ [3]

[1] Holmes, Arthur, 1965, Principles of physical geology: 2d ed., New York, Ronald Press, p. 360-361, for the Pleistocene and Pliocene, and Obradovich, J. D., 1965, Age of marine Pleistocene of California: Am. Assoc. Petroleum Geologists, v. 49, no. 7, p. 1087, for the Pleistocene of southern California.

[2] Geological Society of London, 1964, The Phanerozoic time-scale; a symposium: Geol. Soc. London, Quart. Jour., v. 120, supp., p. 260-262, for the Miocene through the Cambrian.

[3] Stern, T. W., written commun., 1968, for the Precambrian.

[4] Includes provincial series accepted for use in U.S. Geological Survey reports.

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

GEOLOGIC NAMES COMMITTEE, 1970